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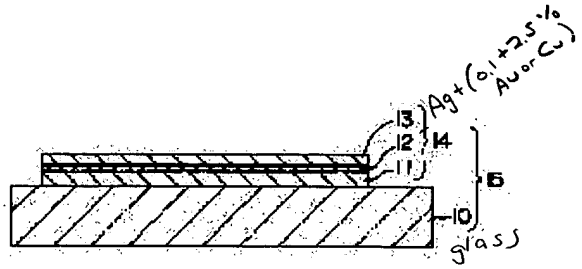
(54) ELECTRODE SUBSTRATE FOR DISPLAY

(57)Abstract:

PROBLEM TO BE SOLVED: To eliminate the deterioration on ageing and to attain preservation stability by using a silver alloy prepared by adding small amts. of gold and copper to silver for an argentine thin film.

SOLUTION: The electrode substrate 15 for a transmission-type display consists essentially of the transparent oxide thin film 11 (oxidic transparent conductive thin film layer) as a conductive adhesive layer, transparent argentine thin film 12 (argentine conductive thin film layer) and transparent oxide thin film 13 (oxidic transparent conductive thin film layer) successively formed on a glass substrate 10. In this case, the argentine conductive thin film layer 12 is formed with a silver alloy added with 0.1-2.5 atomic % gold and 0.3-3.0 atomic % copper, and the oxidic transparent conductive thin film layer 13 is formed by an amorphous material. The addition of only 0.1 atomic % gold to the argentine conductive thin film layer 12 in the substrate 15 is enough to improve the moisture resistance of the conductive adhesive layer 11, argentine conductive thin film layer 12 and oxidic transparent conductive thin film layer 13 as a three-layer conductive film.



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CLAIMS

[Claim]
[Claim 1] The electrode substrate for display characterized by being formed in the electrode substrate which carries out the laminating of a conductive glue line, a silver system electric conduction thin film layer, and the oxide system transparent electric conduction thin film layer to this order of the silver alloy to which the silver system electric conduction thin film layer added a 0.1 - 2.5at% gold and 0.3 - 3.0at% copper, and forming the oxide system transparent electric conduction thin film layer with the amorphous matter on a substrate.
[Claim 2] The electrode substrate for display of the claim 1 publication which is in within the limits whose thickness of the aforementioned silver system electric conduction thin film layer is 50-200nm, and is in within the limits whose thickness of an oxide system transparent electric conduction thin film layer is 40-100nm.
[Claim 3] The electrode substrate for display of the claim 1 publication in which it is in within the limits whose thickness of the aforementioned silver system electric conduction thin film layer is 5-25nm, and the aforementioned conductive glue line contains the aforementioned oxide system transparent electric conduction thin film layer and an oxide of the same kind.
[Claim 4] The electrode substrate for display of the claim 3 publication in which the aforementioned conductive glue line and the whole oxide system transparent electric conduction thin film layer, or a part contains an oxide larger than a refractive index 2.1.
[Claim 5] The electrode substrate for display of claim [in which the aforementioned conductive glue line and an oxide system transparent electric conduction thin film layer contain the oxide chosen out of any, one side, or both among a cerium oxide and titanium oxide] 3, or claim 4 publication.
[Claim 6] The electrode substrate for display of claim [in which the aforementioned conductive glue line and an oxide system transparent electric conduction thin film layer contain indium oxide] 3, or claim 5 publication.

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DETAILED DESCRIPTION

[Detailed description]
[0001]
[The technical field to which invention belongs] About the electrode substrate of a penetrated type electrode (transparent electrode) or a reflected type electrode used for the display for I/O or a solar battery etc. which carries out a direct input from output display or the display screens, such as liquid crystal display equipment and plasma display equipment, conductivity and the light transmission of this invention are high at especially a thin film, and it relates to the electrode substrate which was moreover excellent in the store stability.
[0002]
[Prior art] The electrode plate with which the transparent electric conduction layer of the electrode configuration which penetrates a visible ray was prepared on substrates, such as glass and a plastics film, is widely used for the electrode for a display of various display (display screen), such as liquid crystal display equipment, the I/O electrode which can carry out a direct input from the display screen of this display.
[0003] For example, the transparent-electrode plate of the display unit with which liquid crystal was used The light-filter layer 31 which is prepared in the pixel site on a glass substrate 30 and this glass substrate 30, and colors the transmitted light red, green, and blue for every pixel, respectively as shown in drawing 12 , The shading layer 32 which is prepared in the site between the pixels on the above-mentioned glass substrate 30 (between pixels), and prevents the light transmission from this site, The transparent protection layer 33 prepared the whole surface on the above-mentioned light-filter layer 31, Sputtering ****s on this protection layer 33, and the principal part consists of a transparent electrode 34 of the shape of the shape of a pattern by which it was etched into the predetermined electrode pattern, and solid, and an orientation layer 35 ****ed on this transparent electrode 34.
[0004] ITO thin film which added the tin oxide in indium oxide as this transparent electrode 34 paying attention to the high conductivity is used widely, the specific resistance is 2.4x10-4ohm and cm about, and, in the case of the 240nm thickness usually applied as a transparent electrode, the sheet resistivity value is about 10ohms (or it is called 10ohm/**, and **; square). Moreover, although the tin-oxide thin film, the thin film (Nesa membrane) constituted by the tin oxide by adding an antimony oxide or the thin film constituted by the zinc oxide by adding an aluminum oxide, etc. is known in addition to this, each of these is inferior to the above-mentioned ITO thin film in conductivity, and since an acid, chemical resistance or durability to alkali, etc. is inadequate, generally they has not spread.
[0005] On the other hand, in the 7thICVM held in Japan, the transparent electric conduction layer of the three-tiered structure which the front rear face of a silver thin film is made to carry out the laminating of ITO thin film or the indium oxide thin film (IO thin film), and is constituted as a heat ray reflective layer is proposed in 1982. The transparent electric conduction layer of this three-tiered structure has the low sheet resistivity value of about about 5ohms, and the application to the above-mentioned transparent electrode was expected taking advantage of the high conductivity.
[0006]
[Object of the Invention] By the way, in the above-mentioned display unit or the I/O device, it is required that it is asked for increasing a pixel density and displaying a precise screen in recent years, and precise-ization of the above-mentioned transparent-electrode pattern is demanded in connection with this, for example, the terminal area of the above-mentioned transparent electrode is constituted from a pitch which is about 100 micrometers. Moreover, in the formula (COG) with which the direct file of the IC for a liquid crystal drive is carried out to a substrate in liquid crystal display equipment, there is a fraction from which leading about of a wiring serves as a thin line called the width of face of 20-50 micrometers, and the advanced etching manipulation fitness which is not in the former, and high conductivity (low resistance) are demanded.

[0007] Moreover, on the other hand, it was asked also for large-sized-ization of the display screen, and in order to form the transparent electrode of a precise pattern which was mentioned above and to enable it to impress sufficient driver voltage for liquid crystal moreover about such large-sized screen-ization, the transparent electrode equipped with the high conductivity of the sheet resistivity value of 5ohms or less as the above-mentioned transparent electrode needed to be applied. moreover -- in addition, in the LCD of a simple matrix drive formula using STN LCD etc., when performing a multi-gradation display of 16 or more gradation, the still low sheet resistivity value of 3ohms or less is demanded

[0008] However, it also sets to the transparent electrode of the above-mentioned three-tiered structure proposed in the 7thICVM. By the sheet resistivity value of at most about 5ohms not passing being obtained, but there being a trouble where sufficient conductivity is not securable, for example, making thickness of a silver thin film thick about 16-18nm Even if it is possible to reduce the sheet resistivity value to about 3 ohms, visible-ray permeability (especially a long wave with a wavelength of about 610nm visible-ray permeability by the side of merit) falls to about 75%, and the function as a transparent electrode will be spoiled.

[0009] Furthermore, in the transparent electrode of the above-mentioned three-tiered structure, when it was easy to react with the moisture in the air into which the silver thin film advanced from the laminating sea surface etc., and a reactant was generated on the front face, and a silverfish-like defect was produced, for example, it applied to the transparent electrode of a LCD, the trouble of being easy to produce a display defect etc. was shown in the front face.

[0010] Moreover, a polarizing plate is not used or the reflected type LCD only by one polarizing plate (by LCDs, such as TN type, STN type, ECB type, and OCB type, two polarizing plates are usually used) attracts attention in recent years.

[0011] In addition, the development of the reflected type LCD which ****ed the reflected type electrode which is made to have the function of the reflecting plate of light and a display electrode, and aimed at the cost cut in the liquid crystal cell is furthered.

[0012] This invention persons have proposed using the silver system thin film with the reflection factor of light covering the whole region mostly and higher than an aluminum thin film of a visible region as a reflector. In order to combine with the sulfur compound in air, for a sulfide to be generated by the front face, and for this silver system thin film to have the problem to which a reflection factor tends to fall and to prevent sulfuration of this silver system thin film, the technique of carrying out the laminating of the thin film of a transparent oxide on a silver system thin film is very effective.

[0013] However, when the laminating of the thin film of a transparent oxide was carried out on the silver system thin film, without taking optical conditions into consideration, the reflected light colored it yellow and pink and there was a problem which drops the display quality of a reflected type LCD greatly. Moreover, also in a reflector, there was a fault that moisture resistance was low and a silverfish even generated leaving it with moisture like the transparent electrode of the three-tiered structure mentioned above.

[0014] this invention -- being such -- a trouble -- directing one's attention -- making -- having -- the -- a technical probrem -- ** -- carrying out -- a place -- a thin film -- conductivity -- a visible ray -- permeability -- or -- a reflection factor -- high -- moreover -- passing -- the time -- a degradation -- there is nothing -- a store -- a stability -- having excelled -- transparency -- type -- or -- reflex -- type -- display -- ** -- an electrode -- a substrate -- providing -- things -- it is .

[0015]

[The means for solving a technical problem] It is that this invention is using two technique together as the above-mentioned The means for solving a technical problem, adds the gold and copper with one [little to the silver of a silver system thin film] of them, and suppresses a silver character, and another is amorphous-substance-izing the thin film of a transparent oxide, and losing a silver grain boundary diffusion (silver's tending to start the grain boundary diffusion during the crystal of an oxide).

[0016] Namely, invention concerning the claim 1 of this invention is set to the electrode substrate in which this order carries out the laminating of a conductive glue line, a silver system electric conduction thin film layer, and the oxide system transparent electric conduction thin film layer on a substrate. It is the electrode substrate for display characterized by being formed of the silver alloy to which the silver system electric conduction thin film layer added a 0.1 - 2.5at% gold and 0.3 - 3.0at% copper, and forming the oxide system transparent electric conduction thin film layer with the amorphous matter.

[0017] Moreover, invention concerning a claim 2 is an electrode substrate for display which is in within the limits whose thickness of the aforementioned silver system electric conduction thin film layer is 50-200nm, and is in within

the limits whose thickness of an oxide system transparent electric conduction thin film layer is 40-100nm in the electrode substrate for display of the above-mentioned invention.
[0018] Moreover, invention concerning a claim 3 is an electrode substrate for display in which it is in within the limits whose thickness of the aforementioned silver system electric conduction thin film layer is 5-25nm, and the aforementioned conductive glue line contains the aforementioned oxide system transparent electric conduction thin film layer and an oxide of the same kind in the electrode substrate for display of the above-mentioned invention.
[0019] Moreover, invention concerning a claim 4 is an electrode substrate for display in which the aforementioned conductive glue line and the whole oxide system transparent electric conduction thin film layer, or a part contains an oxide larger than a refractive index 2.1 in the electrode substrate for display of the above-mentioned invention.
[0020] Moreover, invention concerning a claim 5 is an electrode substrate for display in which the aforementioned conductive glue line and an oxide system transparent electric conduction thin film layer contain the oxide chosen out of any, one side, or both among a cerium oxide and titanium oxide in the electrode substrate for display of the above-mentioned invention.
[0021] Moreover, invention concerning a claim 6 is an electrode substrate for display in which the aforementioned conductive glue line and an oxide system transparent electric conduction thin film layer contain indium oxide in the electrode substrate for display of the above-mentioned invention.
[0022]
[Gestalt of implementation of invention] Invention concerning the claim 1 of this invention is explained in detail below according to the gestalt of enforcement.
[0023] In the electrode substrate to which this order carries out the laminating of a conductive glue line, a silver system electric conduction thin film layer, and the oxide system transparent electric conduction thin film layer on a substrate in invention concerning the claim 1 of this invention a silver system electric conduction thin film layer -- 0.1 - 2.5at% (following atomic weight% --) It is the electrode substrate for display in which it is formed in of the silver alloy which added the gold which calls an atomic-weight percent at%, and 0.3 - 3.0at% copper, and the oxide system transparent electric conduction thin film layer is formed with the amorphous matter.
[0024] The addition of the gold to the above-mentioned silver system electric conduction thin film layer on the above-mentioned substrate has the inclination that moisture resistance improves as it is effective from 0.1at% of little addition and makes [many] this addition about the enhancement in moisture resistance respectively of the conductive glue line which is the electric conduction layer of a three-tiered structure, a silver system electric conduction thin film layer, and an oxide system transparent electric conduction thin film layer.
[0025] However, since smuts will become easy to remain at the time of an etching manipulation of an electric conduction layer if the resistance as an electric conduction layer will rise if a golden addition increases, and it carries out to more than 2.5at%, the proper addition needs to be adjusted.
[0026] Silver (Ag) Addition of the copper to a silver system electric conduction thin film layer accepts it while it contributes on a moisture-proof disposition, as described above. by two elements of Ag-Au(gold) Although it is easy to produce change in **** thickness, the permeability after ****, etc. in response to the influence of the oxygen in the gas ambient atmosphere at the time of sputtering **** There is a potency which a depression will be lost if copper (Cu) is added, therefore seldom comes to receive the influence of the ambient atmosphere, and extends the margin at the time of **** of a silver system electric conduction thin film layer (permissible doses, such as **** conditions) especially.
[0027] Specifically, if oxygen exists in the introductory gas or the background at the time of **** of a silver system electric conduction thin film layer mostly, an optical absorption will arise near the wavelength of 470nm, and a fall of the light transmittance (a reflected type electrode reflection factor) as a transparent electrode will arise.
[0028] The transparent silver system electric conduction thin film layer in which drawing 5 was formed of the silver alloy to which the silver system electric conduction thin film layer added a 0.1 - 2.5at% gold and 0at% - 3.0at% copper, It is the graph which shows the spectral transmittance of the transparent electrode substrate for display of the three-tiered structure formed of the oxide system transparent electric conduction thin film layer by the amorphous matter (in the case [Total thickness / of the electric conduction layer of a three-tiered structure /;] of about 85nm). In copper 0at% addition, graph ** graph ** In the case of copper 0.3at% addition In copper 1.0at% addition, for graph **, graph ** is in the case of copper 3.0at% addition, the depressions by the side of short wavelength decrease in number gradually from about 0.3%, and the addition of the copper to the above-mentioned silver system electric conduction thin film layer is effective in raising depression of the permeability by the side of short wavelength, as shown in above-mentioned drawing 5 .
[0029] In order that copper may take eutectic (it is not perfect ****) type to silver, when it will come to have bad

influence on a light transmittance or a reflection factor if a copper addition increases and an addition increases, it has the inclination that the resistance of an electric conduction layer rises.

[0030] For example, when the thickness of the above-mentioned silver system electric conduction thin film layer is set to 10-11nm and a copper addition is made more than 3at%, a sheet resistivity value comes to exceed 5 ohms.

[0031] In order to amorphous-substance-ize the above-mentioned oxide system transparent electric conduction thin film layer, substrate temperature is low set up by the **** methods, such as sputtering, at a certain kind of metallic oxide using the oxide target which carries out considerable-amount (it is generally 20% or more although it changes by compatibility of oxide) mixture of the dissimilar metal, and the amorphous-substance-ized things (for example, 20 degrees C or less or a room temperature etc.) are simple.

[0032] Moreover, what is necessary is just to select from the material which is rich in acid resistance, alkali resistance, and thermal resistance as the above-mentioned metallic oxide.

[0033] Next, the simulation of the reflected type display electrode substrate which carried out the laminating of the conductive glue line (for example, wavelength dispersions, such as 10nm of thicknesss, the refractive index 2.3 however a refractive index by light wave length, and change of an absorption coefficient, were disregarded) by the electric conduction thin film of an oxide system, and 50nm - 200nm of silver system electric conduction thin film layers and an oxide system transparent electric conduction thin film layer (40nm of for example, thicknesss) one by one on the glass substrate the premise [the intended use of a reflector] was

[0034] And the simulation result of the reflection factor of the electric conduction thin film layer of an above-mentioned reflex type display electrode substrate is shown in drawing 11 . In 75nm of the thicknesss of a silver system electric conduction thin film, and graph **, 100nm of the thicknesss of a silver system electric conduction thin film and graph ** show [graph ** / 50nm of the thicknesss of a silver system electric conduction thin film, and graph **] the case of 200nm of the thicknesss of a silver system electric conduction thin film. In addition, the refractive index of the measurement medium (medium which intervenes in the path of a measuring beam) to use was set to 1.5.

[0035] Next, invention concerning the claim 2 of this invention is explained in detail below according to the gestalt of enforcement.

[0036] Invention concerning a claim 2 is an electrode substrate for display which is in within the limits whose thickness of the aforementioned silver system electric conduction thin film layer is 50-200nm, and is in within the limits whose thickness of an oxide system transparent electric conduction thin film layer is 40-100nm in the electrode substrate for display of invention of the above-mentioned claim 1.

[0037] That is, the domain whose thickness of the silver system electric conduction thin film layer as a reflecting layer is 50nm - 200nm has invention concerning a claim 2 on the assumption that the intended use of a reflected type display electrode substrate, and it is in the domain whose thickness of an oxide system transparent electric conduction thin film layer is 40nm - 100nm.

[0038] Drawing 11 will serve as the reflected type electrode before and behind 80% of reflection factors, if the thickness of a silver system electric conduction thin film layer exceeds 50nm, although the influence to the reflection factor of the thickness of a silver system electric conduction thin film layer is shown, a reflection factor is saturated with 200nm, and it is shown that a light transmittance becomes about 0%.

[0039] In drawing 8 and drawing 9 , the simulation result in a reflected type electrode which took the wavelength dispersion into consideration about the relation between the thickness of a silver system electric conduction thin film layer and a reflection factor was shown, and the optical constant (a refractive index, extinction coefficient of light) was respectively shown in Table 1 at them about the silver system electric conduction thin film layer (AgAuCu) and the oxide system electric conduction thin film layer (ICTTO).

[0040]

[Table 1]

	AgAuCu		ICTTO	
波長（nm）	屈折率	消衰係数	屈折率	消衰係数
400	0.1730	1.9500	2.4986	0.0444
410	0.1729	2.0714	2.4736	0.0347
420	0.1666	2.1820	2.4510	0.0275
430	0.1594	2.2835	2.4304	0.0220
440	0.1575	2.3750	2.4116	0.0178
450	0.1510	2.4715	2.3944	0.0145
460	0.1434	2.5674	2.3787	0.0120
470	0.1365	2.6588	2.3643	0.0099
480	0.1316	2.7467	2.3510	0.0083
490	0.1306	2.8313	2.3387	0.0070
500	0.1300	2.9186	2.3274	0.0059
510	0.1299	3.0107	2.3169	0.0051
520	0.1298	3.0979	2.3072	0.0044
530	0.1293	3.1784	2.2981	0.0038
540	0.1286	3.2576	2.2897	0.0033
550	0.1248	3.3404	2.2818	0.0029
560	0.1212	3.4213	2.2745	0.0025
570	0.1202	3.5013	2.2676	0.0022
580	0.1206	3.5800	2.2612	0.0020
590	0.1210	3.6570	2.2551	0.0017
600	0.1243	3.7330	2.2495	0.0016
610	0.1277	3.8076	2.2441	0.0014
620	0.1310	3.8809	2.2391	0.0013
630	0.1338	3.9654	2.2344	0.0011
640	0.1366	4.0481	2.2299	0.0010
650	0.1393	4.1292	2.2256	0.0009
660	0.1400	4.2109	2.2216	0.0008
670	0.1399	4.2918	2.2178	0.0008
680	0.1399	4.3713	2.2142	0.0007
690	0.1402	4.4492	2.2108	0.0006
700	0.1423	4.5250	2.2076	0.0006

[0041] It is shown that the thickness of the above-mentioned oxide system transparent electric conduction thin film layer becomes [the reflection factor of 435nm (blue dominant wavelength)] as low as about 70% by 30nm or less and 110nm or more.

[0042] Moreover, it is shown that the thickness of an oxide system transparent electric conduction thin film layer has a good reflection factor in 40nm - 100nm.

[0043] Next, invention concerning the claim 3 of this invention is explained in detail below according to the gestalt of enforcement.

[0044] Invention concerning a claim 3 is an electrode substrate for display in which it is in within the limits whose thickness of the aforementioned silver system electric conduction thin film layer is 5-25nm, and the aforementioned conductive glue line contains the aforementioned oxide system transparent electric conduction thin film layer and an oxide of the same kind in the electrode substrate for display of invention concerning the above-mentioned claim 1.

[0045] The simulation of the spectral transmittance by the penetrated type display electrode substrate which carried out the laminating of the conductive glue line (for example, 35nm of thicknesss, the refractive index 2.2) by the transparent electric conduction thin film of an oxide system, and 15nm - 25nm of silver system electric conduction thin film layers and an oxide system transparent electric conduction thin film layer (40nm of for example, thicknesss) to drawing 10 one by one on the glass substrate the premise [the intended use of a penetrated type electrode] was shown. For 22.5nm of the thicknesss of a silver system electric conduction thin film layer, and **, 20.0nm of the thicknesss of a silver system electric conduction thin film layer and graph ** are [graph ** / 15nm of the thicknesss of a silver system electric conduction thin film layer, and graph ** / 17.5nm of the thicknesss of a silver system electric conduction thin film layer, and graph **] in the case of 25.0nm of the thicknesss of a silver system electric conduction thin film layer,

and the measurement medium was made into the refractive index 1 as air
[0046] Also in the comparatively thick field whose thickness of a silver system electric conduction thin film layer is 25nm, 80% with the comparatively good permeability of a peak is obtained. Moreover, the sheet resistivity value of the electric conduction layer of a three-tiered structure is set to about 2 ohms by the thickness of a silver system electric conduction thin film layer by a little more than 20nm.
[0047] Moreover, in less than 5nm of thicknesss, it becomes island-like (the shape of a land), and it does not become a homogeneous layer, it becomes difficult to compute the proper optical property and proper resistance on a calculation, and a silver system electric conduction thin film layer does not serve as the good electric conduction layer of three layers in the field of the ultra-thin layer of 5nm or less of thicknesss.
[0048] In addition, the electric conduction layer of the three-tiered structure on condition of a penetrated type display electrode substrate has influence to permeability and resistance with it better [to carry out the laminating to front reverse both-sides side of a silver system electric conduction thin film layer / which the **** status (for example, the conditions at the time of ****, an oxygen tension, etc.) of an oxide system transparent electric conduction thin film layer approximates more mutually, respectively].
[0049] moreover, each by the side of front reverse both sides of a silver system electric conduction thin film layer -- if the **** material of the aforementioned oxide system transparent electric conduction thin film layer is the same, material controls, such as a target for sputtering ****, are also easy
[0050] By the way, the technical progress of the liquid crystal display display of passive matrices, such as STN and ECB, has motion that it is remarkable and a color STN formula will be used as a monitor of CRT alternative, when it is a deferred monitor, the connection with the external power of 100V and 110V is possible for it, and the daily use of the back light of high brightness of it is attained from such a thing in recent years.
[0051] Although priority will be given to the transparent electrode used for this in the liquid crystal display display of the passive matrix of monitor intended use from this viewpoint being low resistance and permeability may be made to some extent into a sacrifice If the influence of the resistance of a transparent electrode is very large and the sheet resistivity value of a transparent electrode mentioned above becomes near 2ohm, since deterioration of the quality of image called shadowing will almost be lost for the enhancement in quality of image in such a passive matrix, It can compete with TFT formula on practical use level as a display.
[0052] Next, invention concerning the claim 4 of this invention is explained in detail below according to the gestalt of enforcement.
[0053] Invention concerning a claim 4 is an electrode substrate for display in which the aforementioned conductive glue line and the whole oxide system transparent electric conduction thin film layer, or a part contains an oxide larger than a refractive index 2.1 in the electrode substrate for display of invention concerning the above-mentioned claim 3.
[0054] When this invention persons repeated the study further, they found out that the configuration of the electric conduction layer of the three-tiered structure which used the oxide with a refractive index larger than 2.1 for the oxide system transparent electric conduction thin film layer obtained a still good result as mentioned above.
[0055] And it found out that an effect was in the enhancement in a light transmittance by inserting the oxide with a high refractive index (the oxide being practical in respect of the manufacturing cost etc., although it does not limit to an oxide, if transparent in the light field) in a glue line, the whole oxide system transparent electric conduction thin film layer, or these parts.
[0056] In the case of the electric conduction layer of the three-tiered structure for the LCD of the liquid crystal material (the refractive index of usual liquid crystal is 1.5 to about 1.6) with a refractive index higher than air (air), and the gestalt which touches a light filter (grade to which the refractive index of the material of a light filter exceeds 1.5 a little), the rise of the light transmittance using a high refractive-index material is remarkable.
[0057] For example, although B line of drawing 6 shows a simulation result in case one side of the transparency type display electrode of the three-tiered structure formed on substrates, such as glass, is air (air), permeability T falls about 96% at a peak till the place where reflection factor R is near 1%, and a result good as a penetrated type display electrode substrate (transparent electrode) is obtained.
[0058] Here, the thickness of the oxide system transparent electric conduction thin film layer (transparent oxide thin film) of the side which touches [thickness / of the glue line by the transparent oxide thin film by the side of a substrate] 14nm and air in the thickness of 40nm and a transparent silver system electric conduction thin film layer (Ag thin film) was set to 44nm. And the refractive index of these transparent oxides thin film was computed as the 2.0 [almost same] as ITO.
[0059] However, 40nm laminating of the orientation layer of a polyimide is carried out on the above-mentioned

transparent electrode of a three-tiered structure, if the refractive index of the liquid crystal which touches this is computed as 1.5, as A line of drawing 6 shows, as for permeability T, a peak will fall to 90% or less, reflection factor R will go up to about 10% near 550nm of light wave length, and the performance as a penetrated type display electrode substrate (transparent electrode) will fall.

[0060] each which pinches this invention persons' silver system electric conduction thin film layer for a calculation in the type where the polyimide layer and liquid crystal as an orientation layer of liquid crystal touch the transparency type display electrode substrate of a three-tiered structure from this, on the front reverse side -- it carried out by changing and optimizing the each refractive index of a transparent oxide thin film (also adjusting a thickness at the same time it changes a refractive index)

[0061] The result is shown in drawing 6 . This drawing shows that the higher one of permeability improves to the grade to which especially the refractive index of a transparent oxide thin film exceeds 2.1, and a reflection factor also falls.

[0062] Next, invention concerning the claim 5 of this invention is explained in detail below according to the gestalt of enforcement.

[0063] Invention concerning a claim 5 is an electrode substrate for display in which the aforementioned conductive glue line and an oxide system transparent electric conduction thin film layer contain the oxide chosen out of any, one side, or both among a cerium oxide and titanium oxide in the electrode substrate for display of invention concerning the above-mentioned claim 3 or the claim 4.

[0064] When premised on a penetrated type display electrode substrate (transparent electrode), permeability is made to improve by using for the transparent oxide thin film used for this invention, and using a high refractive-index material as a material.

[0065] The typical oxides of this high refractive-index material are a cerium oxide and titanium oxide, mix these with a different-species oxide at about 20 - 80% of a rate, and raise the light transmittance of the electric conduction layer of the three-tiered structure as a transparent electrode by forming a transparent conductive glue line and an oxide system transparent electric conduction thin film layer.

[0066] Next, invention concerning the claim 6 of this invention is explained in detail below according to the gestalt of enforcement.

[0067] Invention concerning a claim 6 is an electrode substrate for display in which the aforementioned conductive glue line and an oxide system transparent electric conduction thin film layer contain indium oxide in the electrode substrate for display of invention concerning the above-mentioned claim 3, the claim 4, or the claim 5.

[0068] In the electrode substrate for display of this invention, it is necessary to take an electric conduction from the front face of a transparent oxide thin film for a drive of a display device.

[0069] Moreover, in order to make a transparent oxide thin film amorphous-substance-ize in the type (for example, type where crystallization does not progress in annealing near 250 degree C) stabilized comparatively also thermally, as described above, it is necessary to make it the mixed-oxide thin film of different-species oxide addition in about 20 - 80% of the domain.

[0070] There was little oxide which can take an electric conduction in the state of such an amorphous mixed oxide, and it found out that it was advantageous to make the material of a transparent oxide thin film into indium oxide in the domain which this invention persons examined.

[0071] What is necessary is just to still specifically **** a cerium oxide (or titanium oxide) by the **** technique, such as sputtering, with indium oxide using the oxide target made to mix in about 20 - 80% of the domain. In addition, if it is amorphous as a transparent oxide thin film even if a mixed rate does not go into the above-mentioned domain, it is good.

[0072] Although the electrode substrate for display of this invention includes either a penetrated type or the reflected type electrode substrate for display, when it is a reflected type electrode substrate for display, the substrates to use may be transparent substrates, such as glass and plastics, or white, black, and a transparent or opaque substrate colored other colors, for example. And the material of a substrate can also use various things, such as a substrate in which semiconductor devices, such as contest polysilicon [glass, a plastics film, a plastics sheet, a ceramic a metal plate or an amorphous silicon, and] and MIM, were formed. Moreover, pattern formation of the light-filter layer (for example, red, green, each blue tinction layer) may be carried out beforehand at the aforementioned substrate to use.

[0073] Moreover, since the electric conduction layer of the three-tiered structure of this invention is low resistance, it is also possible to be able to use it for signal lines, bus lines, etc. of an element, such as TFT and MIM, and to use also [electrodes / pixel / these].

[0074]

[Example] The concrete example of this invention is shown below.
[0075] As shown in <example 1> drawing 1 , the penetrated type electrode substrate for display 15 concerning this example The transparent oxide thin film 11 (oxide system transparent electric conduction thin film layer) which is a conductive glue line with a thickness [by which the laminating was carried out one by one on the glass substrate 10 with a thickness of 0.7mm] of 35nm, The principal part consists of a transparent silver system electric conduction thin film 12 (silver system electric conduction thin film layer) with a thickness of 14nm and a transparent oxide thin film 13 (oxide system transparent electric conduction thin film layer) with a thickness of 38nm. in addition, the above-mentioned transparent oxide thin films 11 and 13 -- the any -- although -- the cerium oxide (it is 32at% by the metallic element conversion except oxygen) was made into the mixed oxide added to the thin film of indium oxide Moreover, the above-mentioned transparent oxide thin film 11 and the silver system thin film 12 between 13 are the silver alloys which added golden 1.0at% and copper 1.5at% to silver.
[0076] And the transparent electric conduction layer 14 of the above-mentioned three-tiered structure was ****ed by the following technique. First, after the surfactant and water of an organic alkali system washed the front face of a glass substrate 10, it held in the vacuum tub, the plasma treatment called reverse sputtering was given, and washing processing of the front face was carried out further.
[0077] Next, without taking out a glass substrate 10 out of a vacuum tub, where this glass substrate 10 is maintained to a room temperature, laminating **** of the transparent oxide thin film 11, the silver thin film 12, and the transparent oxide thin film 13 was carried out one by one by the sputtering method.
[0078] Next, on the transparent oxide thin film 13, carry out pattern formation of the resist layer of an electrode configuration by the photolithography method, and the site exposed from this resist layer is etched by the nitric-acid system etching reagent. Where position matching of the thin film of the above-mentioned three-tiered structure is carried out mutually, patterning was carried out to the electrode configuration, then annealing processing of 220 degrees C and 1 hour was performed, the above-mentioned transparent electrode 14 of an electrode configuration was formed, and the penetrated type electrode substrate for display 15 was produced. In this way, the sheet resistivity value of the obtained transparent electrode 14 was about 3.3ohms.
[0079] A solid line shows the visible-ray permeability (graph **) of the transparent electrode 14 of an example 1 which gave the silver system electric conduction thin film layer of the 14nm of the above-mentioned thicknesss to drawing 4 . In addition, the permeability of the transparent electrode 14 (sheet resistivity value; about 4.6ohms) which graph ** gave the silver system electric conduction thin film layer of 12nm or less of thicknesss, and graph ** show the permeability of the transparent electrode 14 (thickness;nm [about 90], sheet resistivity value; about 2.2ohms) which gave the silver system electric conduction thin film layer of 19nm of thicknesss.
[0080] After holding this transparent electrode 14 that carried out pattern formation in 60 degrees C and the ambient atmosphere of 95% of humidity for 500 hours, the front face was observed. Consequently, the front face did not produce appearance change at all. In addition, it was 2.24 when the refractive index of the transparent electrode 14 by this mixed oxide was measured.
[0081] Although the peak of the minute silver by the silver thin film 12 was observed in this transparent electrode 14 when the crystallinity was investigated by thin film X-ray diffraction, the peak of the crystal by the transparent oxide thin films 11 and 13 was not observed.
[0082] And even if the above-mentioned transparent electrode 14 was thermally stable and it heat-treated to 300 degrees C, the peak of a crystal was not observed by the transparent oxide thin film, and most elevation of the sheet resistivity value was not looked at.
[0083] As shown in <example 2> drawing 2 , the reflected type electrode substrate for display 25 concerning this example The oxide thin film 21 (transparence or opaque oxide thin film) with a thickness [which is the conductive glue line by which the laminating was carried out one by one on the glass substrate 20 with a thickness of 0.5mm] of 10nm, The principal part consists of a silver system thin film 22 (silver system electric conduction thin film layer) with a thickness of 150nm and a transparent oxide thin film 23 (oxide system transparent electric conduction thin film layer) with a thickness of 75nm.
[0084] The above-mentioned transparent oxide thin films 21 and 23 considered respectively indium oxide, a cerium oxide, a tin oxide, and titanium oxide as titanium 0.5at% of composition tin 1.0at% cerium 32.5at% indium 66at% at the atomic percent of only the metal atom which does not include an oxygen atom in a number. The sheet resistivity value of the reflective electric conduction layer 24 of these three-tiered structures was about 0.2ohms.
[0085] Although the spectral characteristic of the this reflex type electrode substrate for display 25 was shown in drawing 3 , by 450nm - 700nm, about 90% or more of the high reflection factor was obtained 80% by 400nm.

[0086] And the reflective electric conduction layer 24 of the above-mentioned three-tiered structure was ****ed by the following technique. First, after the surfactant and water of an organic alkali system washed the front face of a glass substrate 20, it held in the vacuum tub, the plasma treatment called reverse sputtering was given, and washing processing of the front face was carried out further.

[0087] Next, without taking out a glass substrate 20 out of a vacuum tub, where this glass substrate 20 is maintained to a room temperature, laminating **** of the transparent oxide thin film 21, the silver thin film 22, and the transparent oxide thin film 23 was carried out one by one by the sputtering method.

[0088] Next, on the transparent oxide thin film 23, carry out pattern formation of the resist layer of an electrode configuration by the photolithography method, and the site exposed from this resist layer is etched by the nitric-acid system etching reagent. Where position matching of the thin film of the above-mentioned three-tiered structure is carried out mutually, patterning was carried out to the electrode configuration, then annealing processing of 220 degrees C and 1 hour was performed, the above-mentioned reflective electric conduction layer 24 of an electrode configuration was formed, and the reflected type electrode substrate for display 25 was produced. In this way, the sheet resistivity value of the obtained reflective electric conduction layer 24 was about 0.2ohms.

[0089] Although the crystal peak of the silver by the silver thin film 22 was observed in the reflective electric conduction layer 24 when crystallinity was investigated by thin film X-ray diffraction, the peak of the crystal by the transparent oxide thin films 21 and 23 was not observed.

[0090] Even if the reflective electric conduction layer 24 was thermally stable and it heat-treated to 300 degrees C, the peak of the crystal by the transparent oxide thin films 21 and 23 was not observed. Moreover, as a result of holding in 60 degrees C and the ambient atmosphere of 95% of humidity for 500 hours and observing the front face, there was also no appearance change and moisture resistance was high.

[0091]

[Effect of the invention] The electrode substrate for display of this invention by using for a silver system thin film the silver alloy which added little gold and little copper to silver Moreover, by being able to give moisture resistance to the electrode substrate for display, and there being an effect which makes a reliability high, and using the with a refractive indexes of 2.1 or more transparent oxide thin film of a high refractive index by making a transparent oxide thin film amorphous simultaneously While it is effective in the high transparency type electrode substrate for display of permeability being obtained, and continuing throughout the wavelength of the light and the reflection factor high reflex type electrode substrate for display being obtained, and it is low resistance in a thin film and good conductivity is shown There is a practical effect as the penetrated type which visible-ray permeability or whose reflection factor is high, moreover does not have a degradation with the passage of time, and was excellent in the store stability, or a reflected type electrode substrate for display.

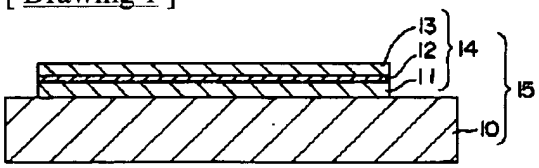
[Translation done.]

* NOTICES *

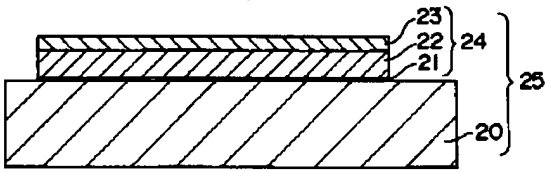
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

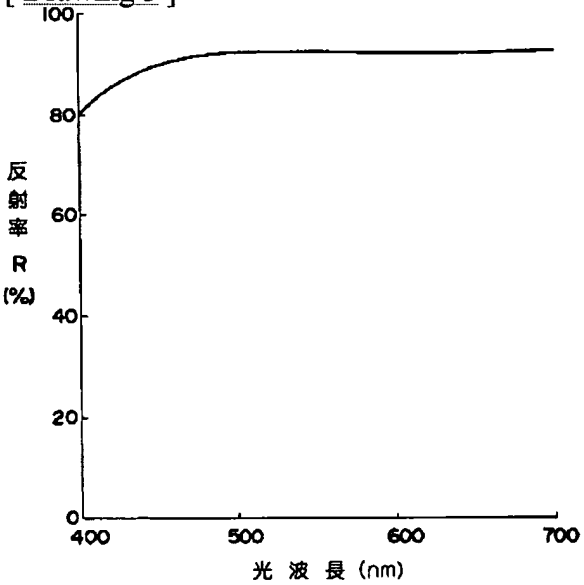
[Drawing 1]



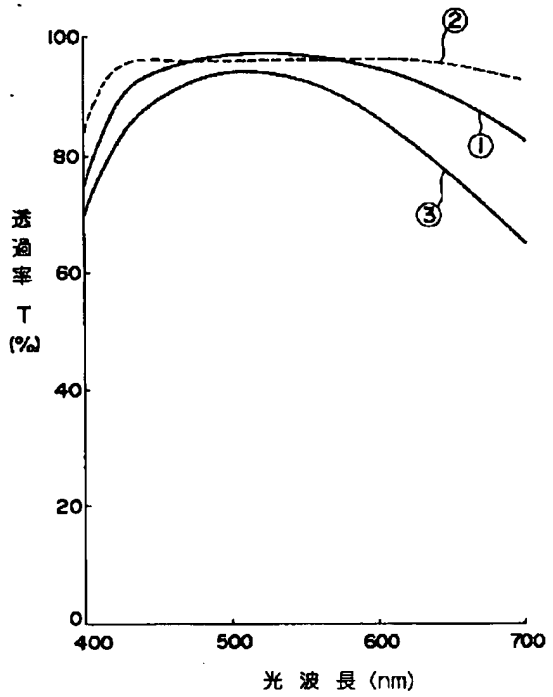
[Drawing 2]



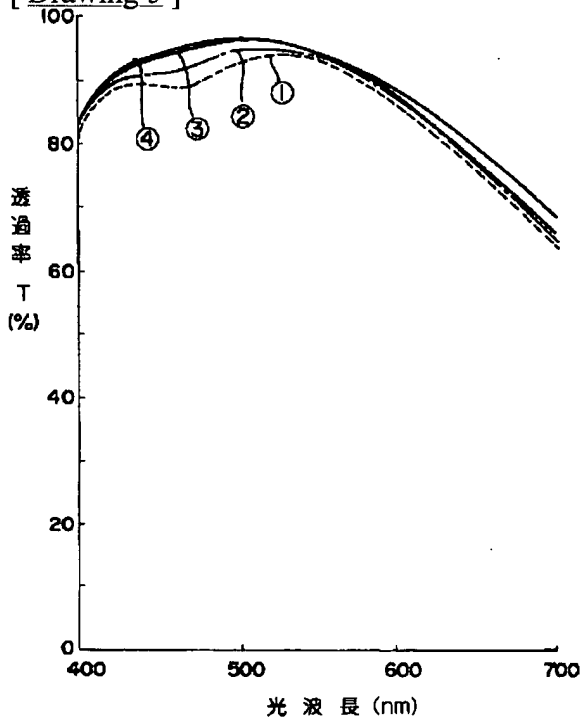
[Drawing 3]



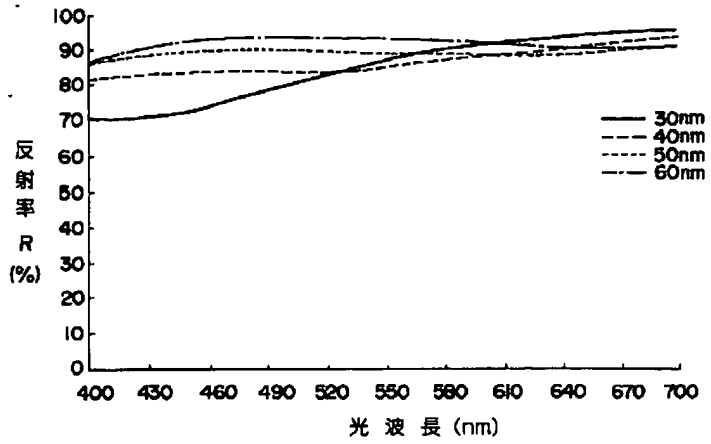
[Drawing 4]



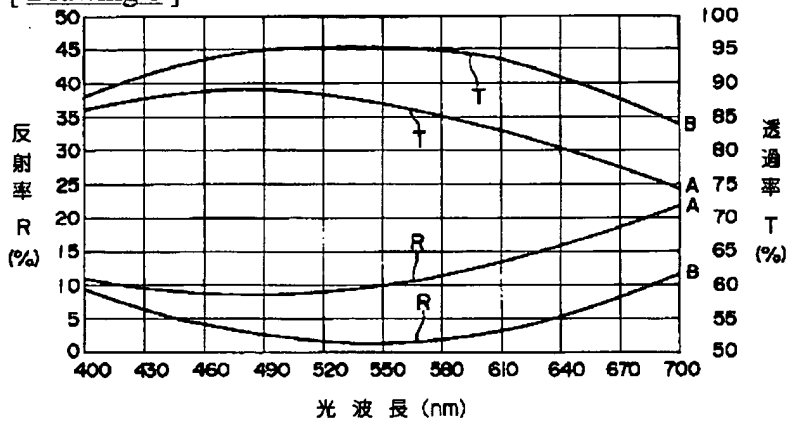
[Drawing 5]



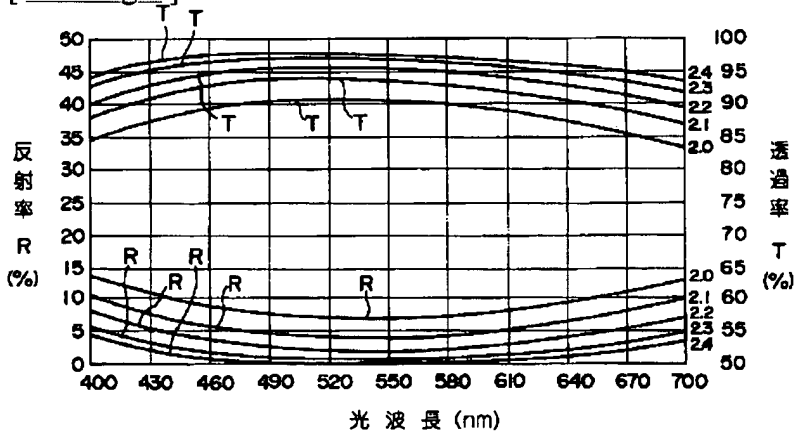
[Drawing 8]



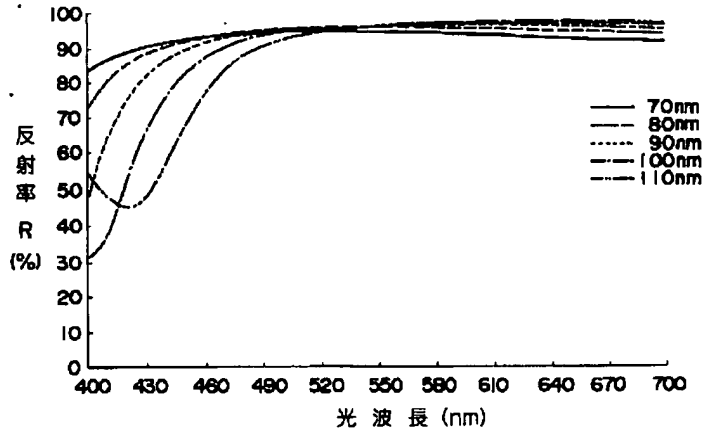
[Drawing 6]



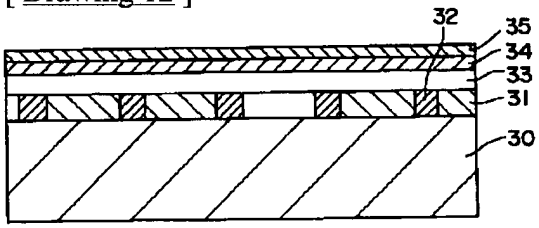
[Drawing 7]



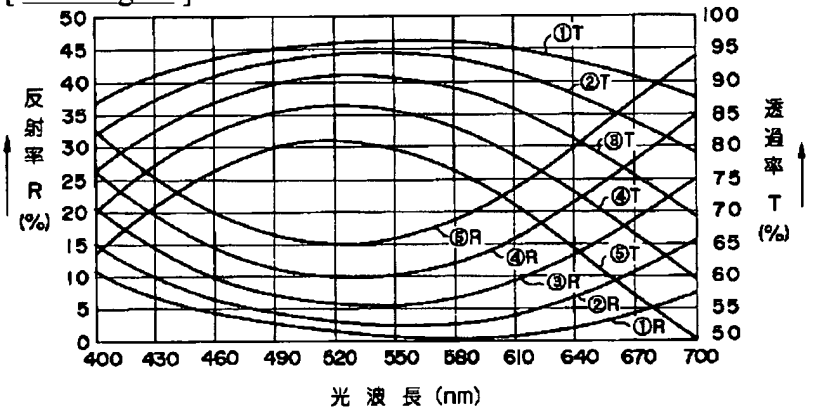
[Drawing 9]



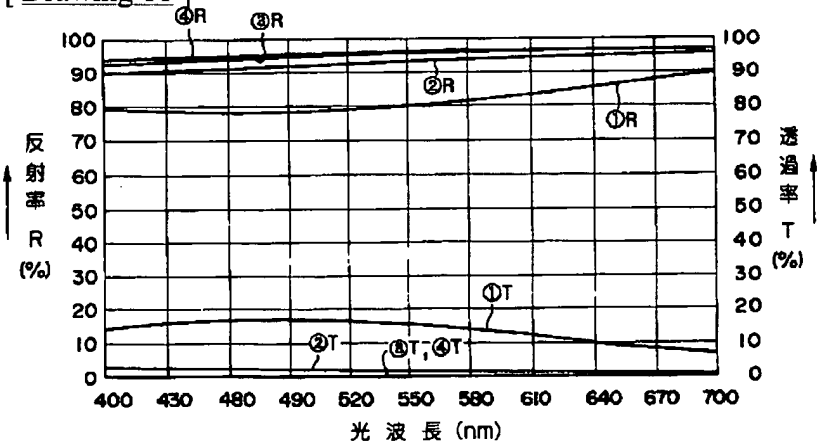
[Drawing 12]



[Drawing 10]



[Drawing 11]



[Translation done.]